THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Previously Presented) A control system for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output, the control system comprising:

a digital controller operable at a sampling frequency, responsive to a sense signal corresponding to the regulated output, to determine a quantity N of output phases to generate, and to generate drive signals to control each of the switch arrays to generate the output phases, the digital controller to control the drive signals at the sampling frequency and to dynamically set a phase interval between each of the output phases, wherein the digital controller is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

2. (Original) The control system of Claim 1 wherein the digital controller includes;

a duty cycle controller to determine a duty cycle of the drive signals; and

a switch controller to generate the drive signals as a function of the duty cycle and the phase interval.

3. (Original) The control system of Claim 1 wherein the digital controller controls a quantity of the switch arrays to enable based on a regulator criteria.

4. (Original) The control system of Claim 3 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

5. (Original) The control system of Claim 1 wherein the digital controller determines a quantity of the switch arrays to enable.

6. (Original) The control system of Claim 1 wherein the multiphase output regulator further includes output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the digital controller to control the switch arrays during turn-on to initialize current flowing through the output filters.

7. (Original) The control system of Claim 1 wherein the sampling frequency is greater than the switching frequency.

8. (Original) The control system of Claim 1 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

the digital controller is operable to dither the drive signals to stretch the pulse width by fractional portions of the clock period.

9. (Previously Presented) A multiphase output regulator for generating a regulated DC output, comprising:

at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

an output filter to filter the output phases; and

a digital controller operable at a sampling frequency, responsive to a sense signal corresponding to the regulated output, to determine a quantity of N output phases to generate, and to generate drive signals to control each of the switch arrays to generate the output phases, the digital controller to control the array duty cycle signals at the sampling frequency and to dynamically set a phase interval between each of the output phases, wherein the digital controller is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

10. (Original) The multiphase output regulator of Claim 9 wherein the digital controller includes;

a duty cycle controller to determine a duty cycle; and

a switch controller to generate the drive signals as a function of the duty cycle and the phase interval.

11. (Original) The multiphase output regulator of Claim 9 wherein the digital controller controls a quantity of the switch arrays to enable based on a regulator criteria.

12. (Original) The multiphase output regulator of Claim 11 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

13. (Original) The multiphase output regulator of Claim 9 wherein the digital controller determines a quantity of the switch arrays to enable.

14. (Original) The multiphase output regulator of Claim 9 wherein the multiphase output regulator further includes output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the digital controller to control the switch arrays during turn-on to initialize current flowing through the output filters.

15. (Original) The multiphase output regulator of Claim 9 wherein the sampling frequency is greater than the switching frequency.

16. (Original) The multiphase output regulator of Claim 9 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

the digital controller is operable to dither the drive signals to stretch the pulse width by fractional portions of the clock period.

17. (Original) The multiphase output regulator of Claim 9 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

18. (Original) The multiphase output regulator of Claim 9 wherein the digital controller includes a control mode selected from the group consisting of voltage mode and current mode.

19. (Original) The multiphase output regulator of Claim 9 wherein each of the switch arrays includes at least two power switches to convert power from the input source to one of the output phases.

20. (Original) The multiphase output regulator of Claim 9 wherein each of the switch arrays includes a current sense circuit to sense a current flowing through the switch array; and

wherein the drive signals are controlled as a function of the current flowing through the switch arrays.

21. (Original) The multiphase output regulator of Claim 9 wherein the output filter includes output filters corresponding to each of the switch arrays.

22. (Previously Presented) A control system for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output, the control system comprising:

means for digital controlling operable at a sampling frequency and responsive to a sense signal corresponding to the regulated output to determine a quantity N of output phases to generate, the digital controlling means, at the sampling frequency, to generate and to control drive signals for the switch arrays and to dynamically set a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval, wherein the means for digital controlling is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

23. (Original) The control system of Claim 22 wherein the digital controlling means includes;

means for duty cycle controlling to determine a duty cycle of the drive signals; and

means for switch controlling to generate the drive signals as a function of the duty cycle and the phase interval.

24. (Original) The control system of Claim 22 wherein the digital controlling means controls a quantity of the switch arrays to enable based on a regulator criteria.

25. (Original) The control system of Claim 24 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

26. (Original) The control system of Claim 22 wherein the digital controlling means determines a quantity of the switch arrays to enable.

27. (Original) The control system of Claim 22 further comprising output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the digital controlling means to control the switch arrays during turn-on to initialize current flowing through the output filters.

28. (Original) The control system of Claim 22 wherein the sampling frequency is greater than the switching frequency.

29. (Original) The control system of Claim 22 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

the digital controlling means is operable to dither the drive signals to stretch the pulse width by fractional portions of the clock period.

30. (Previously Presented) A multiphase output regulator for generating a regulated DC output, comprising:

at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

an output filter to filter the output phases; and

means for digital controlling operable at a sampling frequency and responsive to a sense signal corresponding to the regulated output to determine a quantity N of output phases to generate, the digital controlling means, at the sampling frequency, to generate and to control drive signals for the switch arrays and to dynamically set a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval, wherein the means for digital controlling is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

31. (Original) The multiphase output regulator of Claim 30 wherein the digital controlling means includes;

means for duty cycle controlling to determine a duty cycle; and

means for switch controlling to generate the drive signals as a function of the duty cycle and the phase interval.

32. (Original) The multiphase output regulator of Claim 30 wherein the digital controlling means controls a quantity of the switch arrays to enable based on a regulator criteria.

33. (Original) The multiphase output regulator of Claim 32 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

34. (Original) The multiphase output regulator of Claim 30 wherein the digital controlling means determines a quantity of the switch arrays to enable.

35. (Original) The multiphase output regulator of Claim 30 further comprising output filters corresponding to each of the switch arrays to filter the output phases; and wherein the digital controlling means to control the switch arrays during turn-on to initialize current flowing through the output filters.

36. (Original) The multiphase output regulator of Claim 30 wherein the sampling frequency is greater than the switching frequency.

37. (Original) The multiphase output regulator of Claim 30 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

the digital controlling means is operable to dither the drive signals to stretch the pulse width by fractional portions of the clock period.

38. (Original) The multiphase output regulator of Claim 30 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

39. (Original) The multiphase output regulator of Claim 30 wherein the digital controlling means includes a control mode selected from the group consisting of voltage mode and current mode.

40. (Original) The multiphase output regulator of Claim 30 wherein each of the switch arrays includes at least two power switches to convert power from the input source to one of the output phases.

41. (Original) The multiphase output regulator of Claim 30 wherein each of the switch arrays includes a current sense circuit to sense a current flowing through the switch array; and

wherein the digital controlling means controls the drive signals as a function of the current flowing through the switch arrays.

42. (Original) The multiphase output regulator of Claim 30 wherein the output filter includes output filters corresponding to each of the switch arrays.

43. (Previously Presented) A method for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output, the method comprising:

operating a digital controller at a sampling frequency;

receiving a sense signal corresponding to the regulated output;

based on the sense signal, determining a quantity N of output phases to generate;

generating drive signals to control the switch arrays;

controlling the drive signals;

dynamically setting a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval; and

selectively setting the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

44. (Original) The method of Claim 43 further comprising determining a duty cycle of the drive signals; and

generating the drive signals as a function of the duty cycle and the phase interval.

45. (Original) The method of Claim 43 further comprising controlling a quantity of the switch arrays to enable based on a regulator criteria.

46. (Original) The method of Claim 45 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

47. (Original) The method of Claim 43 further comprising determining a quantity of the switch arrays to enable.

48. (Original) The method of Claim 43 further comprising providing output filters corresponding to each of the switch arrays to filter the output phases; and

controlling the switch arrays during turn-on to initialize current flowing through the output filters.

49. (Original) The method of Claim 43 wherein the sampling frequency is greater than the switching frequency.

50. (Original) The method of Claim 43 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

dithering the drive signals to stretch the pulse width by fractional portions of the clock period.

51. (Previously Presented) A method for generating a regulated DC output, comprising:

providing at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

providing an output filter to filter the output phases; and

operating a digital controller at a sampling frequency;

receiving a sense signal corresponding to the regulated output;

based on the sense signal, determining a quantity N of output phases to generate;

generating drive signals to control the switch arrays;

controlling the drive signals;

dynamically setting a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval; and

selectively setting the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

52. (Original) The method of Claim 51 further comprising determining a duty cycle; and

generating the drive signals as a function of the duty cycle and the phase interval.

53. (Original) The method of Claim 51 further comprising controlling a quantity of the switch arrays to enable based on a regulator criteria.

54. (Original) The method of Claim 53 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

55. (Original) The method of Claim 51 determining a quantity of the switch arrays to enable.

56. (Original) The method of Claim 51 further comprising providing output filters corresponding to each of the switch arrays to filter the output phases; and

controlling the switch arrays during turn-on to initialize current flowing through the output filters.

57. (Original) The method of Claim 51 wherein the sampling frequency is greater than the switching frequency.

58. (Original) The method of Claim 51 wherein the drive signals have a pulse width and the sampling frequency has a corresponding clock period; and

dithering the drive signals to stretch the pulse width by fractional portions of the clock period.

59. (Original) The method of Claim 51 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

60. (Original) The method of Claim 51 further comprising sensing a current flowing through the switch array; and

controlling the drive signals as a function of the current flowing through the switch arrays.

61. (Original) The method of Claim 51 wherein providing the output filter includes providing output filters corresponding to each of the switch arrays.

62. (Previously Presented) A control system for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output, the control system comprising:

a controller, responsive to a sense signal corresponding to the regulated output, to determine a quantity N of output phases to generate, and to generate drive signals to

control each of the switch arrays to generate the output phases, the drive signals including pulses having leading edges and trailing edges; and

the controller to control one of the leading edges and the trailing edges of the drive signals to dynamically set a phase interval between each of the output phases, and to control the other of the leading edges and trailing edges of the drive signals to regulate the regulated output, wherein the controller is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

63. (Original) The control system of Claim 62 wherein the controller includes;

a duty cycle controller to determine a duty cycle of the drive signals; and

a switch controller to generate the drive signals as a function of the duty cycle and the phase interval.

64. (Original) The control system of Claim 62 wherein the controller controls a quantity of the switch arrays to enable based on a regulator criteria.

65. (Original) The control system of Claim 64 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

66. (Original) The control system of Claim 62 wherein the controller determines a quantity of the switch arrays to enable.

67. (Original) The control system of Claim 62 wherein the multiphase output regulator further includes output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the controller to control the switch arrays during turn-on to initialize current flowing through the output filters.

68. (Previously Presented) A multiphase output regulator for generating a regulated DC output, comprising:

at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

an output filter to filter the output phases; and

a controller, responsive to a sense signal corresponding to the regulated output, to determine a quantity N of output phases to generate, and to generate drive signals to control each of the switch arrays to generate the output phases, the drive signals including pulses having leading edges and trailing edges; and

the controller to control one of the leading edges and the trailing edges of the drive signals to dynamically set a phase interval between each of the output phases, and to control the other of the leading edges and trailing edges of the drive signals to regulate the regulated output, wherein the controller is adapted to selectively set the

phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

69. (Original) The multiphase output regulator of Claim 68 wherein the controller includes;

a duty cycle controller to determine a duty cycle; and

a switch controller to generate the drive signals as a function of the duty cycle and the phase interval.

70. (Original) The multiphase output regulator of Claim 68 wherein the controller controls a quantity of the switch arrays to enable based on a regulator criteria.

71. (Original) The multiphase output regulator of Claim 70 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

72. (Original) The multiphase output regulator of Claim 68 wherein the controller determines a quantity of the switch arrays to enable.

73. (Original) The multiphase output regulator of Claim 68 wherein the multiphase output regulator further includes output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the controller to control the switch arrays during turn-on to initialize current flowing through the output filters.

74. (Original) The multiphase output regulator of Claim 68 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

75. (Original) The multiphase output regulator of Claim 68 wherein each of the switch arrays includes a current sense circuit to sense a current flowing through the switch array; and

wherein the drive signals are controlled as a function of the current flowing through the switch arrays.

76. (Previously Presented) A control system for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output, the control system comprising:

means for output controlling, responsive to a sense signal corresponding to the regulated output, to determine a quantity N of output phases to generate, and to

generate drive signals to control each of the switch arrays to generate the output phases, the drive signals including pulses having leading edges and trailing edges; and the output controlling means to control one of the leading edges and the trailing edges of the drive signals to dynamically set a phase interval between each of the output phases, and to control the other of the leading edges and trailing edges of the drive signals to regulate the regulated output, wherein the means for digital controlling is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

77. (Original) The control system of Claim 76 wherein the output controlling means includes;

means for duty cycle controlling to determine a duty cycle of the drive signals; and

means for switch controlling to generate the drive signals as a function of the duty cycle and the phase interval.

78. (Original) The control system of Claim 76 wherein the output controlling means controls a quantity of the switch arrays to enable based on a regulator criteria.

79. (Original) The control system of Claim 78 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input

voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

80. (Original) The control system of Claim 76 wherein the output controlling means determines a quantity of the switch arrays to enable.

81. (Original) The control system of Claim 76 wherein the multiphase output regulator further includes means for filtering corresponding to each of the switch arrays to filter the output phases; and

wherein the output controlling means to control the switch arrays during turn-on to initialize current flowing through the filtering means.

82. (Previously Presented) A multiphase output regulator for generating a regulated DC output, comprising:

at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

means for filtering to filter the output phases; and

means for output controlling, responsive to a sense signal corresponding to the regulated output, to determine a quantity N of output phases to generate, and to generate drive signals to control each of the switch arrays to generate the output phases, the drive signals including pulses having leading edges and trailing edges; and

the output controlling means to control one of the leading edges and the trailing edges of the drive signals to dynamically set a phase interval between each of the output phases, and to control the other of the leading edges and trailing edges of the drive signals to regulate the regulated output, wherein the means for output controlling is adapted to selectively set the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

83. (Original) The multiphase output regulator of Claim 82 wherein the output controlling means includes;

means for duty cycle controlling to determine a duty cycle; and

means for switch controlling to generate the drive signals as a function of the duty cycle and the phase interval.

84. (Original) The multiphase output regulator of Claim 82 wherein the output controlling means to control a quantity of the switch arrays to enable based on a regulator criteria.

85. (Original) The multiphase output regulator of Claim 84 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

86. (Original) The multiphase output regulator of Claim 82 wherein the output controlling means to determine a quantity of the switch arrays to enable.

87. (Original) The multiphase output regulator of Claim 82 wherein the multiphase output regulator further includes output filters corresponding to each of the switch arrays to filter the output phases; and

wherein the output controlling means to control the switch arrays during turn-on to initialize current flowing through the output filters.

88. (Original) The multiphase output regulator of Claim 82 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

89. (Original) The multiphase output regulator of Claim 82 wherein each of the switch arrays includes a means for sensing current to sense a current flowing through the switch array; and

wherein the drive signals are controlled as a function of the current flowing through the switch arrays.

90. (Previously Presented) A method for controlling a multiphase output regulator having a regulated DC output and operating at a switching frequency, the multiphase output regulator including at least two switch arrays to generate individually

controllable output phases from an input source, the output phases to combine to form the regulated DC output, the method comprising:

receiving a sense signal corresponding to the regulated output;

based on the sense signal, determining a quantity N of output phases to generate;

generating drive signals to control the switch arrays, the drive signals including pulses having leading edges and trailing edges;

controlling a one of the leading and trailing edges of the drive signals to set a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval;

controlling the other of the leading and trailing edges of the drive signals to regulate the regulated DC output; and

selectively setting the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

91. (Original) The method of Claim 90 further comprising determining a duty cycle of the drive signals; and

generating the drive signals as a function of the duty cycle and the phase interval.

92. (Original) The method of Claim 90 further comprising controlling a quantity of the switch arrays to enable based on a regulator criteria.

93. (Original) The method of Claim 92 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

94. (Original) The method of Claim 90 further comprising determining a quantity of the switch arrays to enable.

95. (Original) The method of Claim 90 further comprising providing output filters corresponding to each of the switch arrays to filter the output phases; and

controlling the switch arrays during turn-on to initialize current flowing through the output filters.

96. (Previously Presented) A method for generating a regulated DC output, comprising:

providing at least two switch arrays to operate at a switching frequency to generate individually controllable output phases from an input source, the output phases to combine to form the regulated DC output;

providing an output filter to filter the output phases;

receiving a sense signal corresponding to the regulated output;

based on the sense signal, determining a quantity N of output phases to generate;

generating drive signals to control the switch arrays, the drive signals including pulses having leading edges and trailing edges;

controlling the drive signals;

controlling a one of the leading and trailing edges of the drive signals to set a phase interval between each of the drive signals so that the output phases have a dynamically controlled phase interval;

controlling the other of the leading and trailing edges of the drive signals to regulate the regulated DC output; and

selectively setting the phase interval to one of greater than 360/N or less than 360/N, where N is an integer greater than 1.

97. (Original) The method of Claim 96 further comprising determining a duty cycle; and

generating the drive signals as a function of the duty cycle and the phase interval.

98. (Original) The method of Claim 96 further comprising controlling a quantity of the switch arrays to enable based on a regulator criteria.

99. (Original) The method of Claim 98 wherein the regulator criteria is selected from a group consisting of output current, power switch current for any of the switch arrays, output inductor current, output voltage, output ripple voltage, input

voltage, noise generation, power consumption in discrete components, power consumption in circuits, power consumption in the multiphase output regulator.

100. (Original) The method of Claim 96 determining a quantity of the switch arrays to enable.

101. (Original) The method of Claim 96 further comprising providing output filters corresponding to each of the switch arrays to filter the output phases; and

controlling the switch arrays during turn-on to initialize current flowing through the output filters.

102. (Original) The method of Claim 96 wherein the regulated output is selected from a group consisting of output voltage, output current, and output power.

103. (Original) The method of Claim 96 further comprising sensing a current flowing through the switch array; and

controlling the drive signals as a function of the current flowing through the switch arrays.

104. (Original) The method of Claim 96 wherein providing the output filter includes providing output filters corresponding to each of the switch arrays.